

otherwise found allowable if rewritten in independent form including the limitations of their base and any intervening claims. Claims 28, 29, and 37-41 were also found allowable if rewritten to overcome the rejections under '112 and to include the limitations of their base and any intervening claims. It is also noted that the Specification was required to be updated to replace "Attorney Docket Numbers" with their corresponding US Application numbers.

By way this response, claims 1, 49, and 50 have been rewritten to provide a more refined definition of the claimed subject matter to further distinguish over the art and provide the Applicant protection for what is regarded as the invention. Claims 20 and 28 have been amended to avoid their further rejection for informalities of record and rejection of those claims dependent therefrom for similar reasons. In addition, the specification has been amended to replace Attorney Docket numbers with official Application numbers.

Applicants gratefully acknowledge that certain claims have been indicated as allowable but have not rewritten them in independent form at this time. Applicants rather reserve the right to rewrite those claims following examination of the claims now pending based on the amendments and arguments submitted herewith.

Specification

The specification has been amended to properly reflect the current official Application numbers previously identified by Attorney Docket Numbers. Based on an examination of the internal records of this office, the Application Numbers corresponding to the previous Docket numbers are believed to be correct, and their entry is respectfully requested.

Claims Rejections - 35 USC § 112

Claims 20-26, 28, 29, and 36-41 were rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention, the Action stating that:

These claims recite the limitation "retroreflector" which does not have proper antecedent basis in parent claim 5. It is indefinite whether the scope is intended to encompass a generic "optical system" or the more specific "retroreflector."

In response to this rejection, Applicant's have amended claims 20 and 28 by replacing the word "retroreflector" with --optical system-- so there should be no further rejection of these claims, nor those dependent therefrom, on this basis. Withdrawal of this rejection is accordingly requested.

Claim Rejections - 35 USC § 102

Claims 1-4 and 6-8 were rejected under 35 U.S.C. 102(b) as being clearly anticipated by Slotwinski et al. ('251) (Fig. 2 and column 1 lines 10-11), and claim 49 was rejected under 35 U.S.C. 102(b) as being clearly anticipated by Ai et al. ('112) (Fig. 9).

Claim Rejections -35 USC § 103

Claims 5, 20-22, 25, 27, 30, 33, and 36 were rejected under 35 U.S.C. 103(a) as being unpatentable over Slotwinski et al. in view of Reeder (,986), the Action stating that:

As applied to claim 1 above, Slotwinski et al. disclose a polarization interferometer using a fiber as the polarization-preserving optical system, but without expressly disclosing changes in input/output direction. However, Slotwinski et al. disclose prior art (column 3 lines 25-55) polarization interferometry with a disadvantage of reflectors needing very close optical alignment. Reeder discloses a polarization-preserving retroreflector (Fig. 2) that would obviate such a disadvantage. It would have been obvious to one of ordinary skill in the art to use the teaching of Reeder in a known prior-art polarization interferometer to obtain applicant's invention as claimed, the motivation for which would have been to avoid needing "very close optical alignment" (Slotwinski et al. column 3 lines 55-57).

As to claims 22 and 25, it is obvious and known in the art that separate prisms (Reeder column 7 lines 63-64) with surfaces in optical contact are functionally equivalent to a monolithic prism. As to claim 36, rearrangement of the same prisms would have been an obvious functionally equivalent design choice.

Claims 9-19 and 50-52 were rejected under 35 U.S.C. 103(a) as being obvious over Reeder, the Action stating that:

As applied above, Reeder discloses a polarization-preserving retroreflector, and it would have been obvious to use such a retroreflector at the ends of known or obvious configurations of two-arm interferometers.

Claim 35 was rejected under 35 U.S.C. 103(a) as being unpatentable over Slotwinski et al. in view of Reeder, further in view of Lehmann et al. (.864), the Action stating that:

As applied to claim 5 above, a polarization-preserving interferometer would have been obvious, except for the claimed limitation of preselected angles. Lehmann et al. disclose teaching of preselected angles for retroreflectors; and it would have been well-known and obvious to one of ordinary skill to take advantage of the polarizing properties of Brewster's angle as a design choice in the above-applied obvious combination.

Claims 42-44 were rejected under 35 U.S.C. 103(a) as being unpatentable over Reeder as applied to claim 5 above, and further in view of Rando (.476), the Action stating that:

Polarization interferometers are well known in the art, and it would have been obvious to combine them with the teachings of Reeder as applied above. The further limitations of oppositely-tilted plates to reduce ghosts are taught by Rando (by optimizing transmittance at Brewster's angle, column 2 lines 40-44). It would have been obvious to one of ordinary skill in the art to combine the teaching of Rando with that of Reeder and the prior art, the motivation for which would have been to optimize transmittance and minimize ghosting.

The Present Invention

The present invention relates to polarization interferometric apparatus that utilize polarization preserving optical systems to deviate plane polarized beams through preselected angles without changing their linear polarization. The inventive polarization interferometric apparatus have a variety of applications and are particularly suitable for use in distance measuring interferometry (DMI) to achieve higher measurement accuracy than is otherwise possible. This is achieved by reducing undesirable polarization effects that can introduce errors associated with an otherwise present undesirable polarization rotation found in classical retroreflectors. Such interferometers find additional utility in the fabrication of integrated circuits via microlithographic techniques.

While a number of embodiments of the polarization interferometric apparatus of the invention are described, they all share in common the use of interferometer means for receiving at least two beams having orthogonal states of polarization and

providing first and second interferometer legs, separating the two beams for travel along the first and second interferometer legs, respectively, and generating exit beams containing information about the respective differences in the optical paths each beam experienced in traveling the first and second interferometer legs. The first and second interferometer legs have optical paths structured and arranged such that at least one of them has a variable physical length, and the optical path length difference between the first and second interferometer legs varies in accordance with the difference between the respective physical lengths of their optical paths and wherein at least one of the first and second interferometer legs comprises a polarization preserving optical system.

The polarization preserving optical systems used in the polarization interferometric apparatus of the invention comprise a plurality of reflecting surfaces arranged such that a change in the direction of propagation of an input beam, normal to both the input beam and an output beam, causes a change in the direction of propagation of the output beam in a direction opposite to the direction of the change in the input beam, and a change in the direction of propagation of the input beam, normal to the input beam and in a plane orthogonal to a normal to both the input beam and the output beam, causes a rotation in the output beam in the plane that is the same as a corresponding rotation of the input beam caused by the change in the direction of propagation of the input beam and wherein the plane of incidence at each of the reflecting surfaces is either orthogonal or parallel to the plane of polarization of an incident beam thereto. This properties are referred to as their transformation and polarization maintaining properties.

The polarization preserving optical systems are preferably fabricated of a plurality of prismatic optical elements wherein the plurality of reflecting surfaces comprise selected surfaces of the prismatic optical element and preferably operate by total internal reflection.

The plurality of prismatic optical elements are preferably arranged as an integral assembly in which at least one surface of each prismatic optical element contacts at least one surface of another prismatic optical element and in which at least one polarizing beam splitter may be included.

The prismatic optical elements are selected from the group consisting of Porro, right angle, Dove, penta, and "K" prisms, one embodiment comprises a sequential combination of a right angle prism, a Porro prism, and a pentaprism.

At least one of the plurality of reflecting surfaces may have formed thereon a multilayer polarizing beam splitter coating arrangement to enhance the extinction ratio between orthogonally polarized beams entering the polarization preserving optical system and originating upstream of it, and such coatings may be structured to operate at multiple wavelengths. Birefringent materials may also be used to construct the various prismatic optical elements for similar purposes.

A variety of input to output beam relationships is demonstrated and depend on the particular design geometry of a system.

Examples of polarization interferometric apparatus in which polarization preserving optical systems are used include, but are not limited to, plane mirror, high stability plane mirror, differential plane mirror, column reference, and dual linear/angular interferometers.

Means are also provided for generating at least two input beams that are orthogonally polarized, may be coextensive and overlapping or be spatially separated, and may operate at more than one wavelength, which may or may not be harmonically related.

Also included are means for combining the exit beams to produce mixed optical signals containing information corresponding to the phase differences between each of the exit beams from corresponding ones of the predetermined optical paths of the first and second interferometer legs.

Further included are means for detecting the mixed optical signals and generating electrical interference signals containing information corresponding to the difference in physical path lengths of the interferometer legs and their relative rate of change, and electronic means for analyzing the electrical interference signals.

At least one of the interferometer legs preferably includes retardation elements for controlling the state of polarization of orthogonally polarized beams and reducing the effects of ghost reflections on exit beams.

The interferometer means, which typically include a plurality of opposing surfaces, preferably have at least some of them tilted with respect to others to reduce the effects of ghost beams on exit beams.

The 35 USC §102 Rejections

The legal requirements for sustaining this rejection are well-established as articulated in the case law interpreting 35 USC §102. See for example:

Akzo N.V. v. U.S. International Trade Commission, 1 USPQ 2d 1241, 1245 (Fed. Cir. 1986), ***cert. denied***, 482 U.S. 909 (1987)

"Under 35 U.S.C. §102, anticipation requires that each and every element of the claimed invention be disclosed in the prior art. . . . In addition, the prior art reference must be enabling, thus placing the allegedly disclosed matter in the possession of the public."

W.L. Gore & Associates v. Garlock, Inc., 220 USPQ 303, 313 (Fed. Cir. 1983), ***cert. denied***, 469 U.S. 851 (1984)

"Anticipation requires the disclosure in a single prior art reference of each element of the claim under consideration."

Lindemann Maschinenfabrik GmbH v. American Hoist & Derrick Co., 221 USPQ 481, 485 (Fed. Cir. 1984) (emphasis added)

"Anticipation requires the presence in a single prior art reference disclosure of each and every element of the claimed invention, *arranged as in the claim.*"

Thus, the requirements under '102 demand that a single reference contain each and every element recited in the relevant claim and that the specification contain an enabling disclosure in support of each claim limitation. Slotwinski, et al. does not meet this rigorous standard because it does not have, as called for in original claim 1 and rewritten claim 1, a "polarization preserving optical system" that resides in "at least one of said first and second interferometer legs". In the Slotwinski, et al. patent, the fiber is only used for transporting laser light to the interferometer thereof and for transporting a mixed return beam from the interferometer thereof. What is clear is that the interferometer of Slotwinski, et al. begins and ends in the probe head 24. The polarization preserving fiber 22 delivers a source light beam to the probe head 24. After traveling through probe head 24, where the reference and measurement legs of its interferometer reside, the fiber 22 transports a mixed return beam to a photodetector 40. The purpose of the fiber 22 is to immunize the system against environmental changes in polarization that may occur before the source enters the interferometer and after the signal leaves it. It does nothing to influence polarization

properties of the beams within the interferometer itself. Thus configured, it can deliver a source beam to the interferometer from a remotely located laser source and return a signal beam to a photodetector that is also remotely located while in the process preserving polarization within itself to its own specifications. Consequently, it is improper to equate the externally located polarization preserving fiber of Slotwinski, et al. with the claimed "polarization preserving optical system" resident in "at least one of the legs" of the claimed interferometer, which does influence polarization control in the interferometer per se. In addition, rewritten claim 1 now further defines the nature of the polarization preserving optical system of the claimed invention to assure that it may not be interpreted as a "polarization preserving fiber". Consequently, the Slotwinski, et al. reference, rather than being "clearly anticipatory", utterly fails to qualify as a legally sound reference that meets the standards for rejection under 35 USC § 102 because it does not contain each and every claimed element as required. Accordingly, this rejection should be withdrawn.

In as much as the rejection of claims 2, 3, 4, and 6-8 are dependent from claim 1, they are inherently rejected on the basis of a fatally flawed '102 reference, so rejection of those claims should likewise be withdrawn.

The '102 rejection of claim 49 should be withdrawn in view of the limitations now present in its rewritten form. The rewritten version of claim 49 now requires the combination, among other things, of a polarization preserving optical system resident in one of the legs of its interferometer and differently tilted retardation elements to reduce the effects of ghost beams. Ai, et al. clearly does not show or teach this combination as clearly called for by ". . . said interferometer means further including a polarization preserving optical system structured and arranged to deviate plane polarized beams through preselected angles while maintaining their linear polarization as they travel along said at least one of said first and second interferometer legs and a plurality of differently tilted retardation elements to reduce the effects of ghost beams on exit beams (Rewritten claim 49)". Withdrawal of the '102 rejection based on Ai, et al. is therefore respectfully requested.

35 USC §103 Rejection

It must be kept in mind that for a proper rejection under 35 USC 103, it first must be determined whether a prima facie case for obviousness exists. In

determining whether such a case exists, it is necessary to show that the prior art teachings are sufficient to have **suggested** making the claimed modifications to one of ordinary skill in the art; the prior art **and not the Applicant's teachings** must provide one of ordinary skill in the art the motivation to make the proposed modification. See, for example, In re Lahu, 747 F.2d 703, 223 USPQ 1257, 1258 (Fed. Cir. 1984). Cf. Uniroyal, Inc. v. Rudkin-Wiley Corp., 837 F.2d 1044, 5 USPQ2d 1434 (Fed. Cir. 1988) ("Something in the prior art as a whole must suggest the desirability and thus the obviousness, of making the combination.")

With respect to further case law regarding the kind of suggestiveness required see also:

In re Laskowski, 871 F.2d 115, 10 USPQ 2d 1397 (Fed. Cir. 1989)

"Although the Commissioner suggests that [the structure in the primary prior art reference] could readily be modified to form the [claimed] structure, [t]he mere fact that the prior art reference could be so modified would not have made the modification obvious unless the prior art suggested the desirability of the modification."

Northern Telecom, Inc. v. Datapoint Corp., 908 F.2d 931, 15 USPQ2d 1321 (Fed. Cir. 1990)

"It is insufficient that the prior art disclosed the components of the patented device, either separately or used in other combinations; there must be some teaching, suggestion, or incentive to make the combination made by the inventor."

Nor may the applicant's own teachings be used to piece together the claimed invention from the prior art references. See, for example,

In re Gorman, 933 F.2d 982, 18 USPQ2d 1885 (Fed. Cir. 1991)

"As in all determinations under 35 U.S.C. section 103, the decision maker must bring judgment to bear. It is impermissible, however, simply to engage in a hindsight reconstruction of the claimed invention, using the applicant's structure as a template and selecting elements from references to fill the gaps."

In re Fitch, 972 F.2d 1260, 23 USPQ2d 1780 (Fed. Cir. 1992)

" [I]t is impermissible to use the claimed invention as an instruction manual or template to piece together the teachings of the prior art so that the claimed invention is rendered obvious ... This court has previously stated that [o]ne cannot use hindsight reconstruction to pick and choose among isolated disclosures in the prior art to deprecate the claimed invention. "

Texas Instruments Inc. v. U.S. Int'l Trade Comm'n, 988 F.2d 1165, 26 USPQ2d 1018 (Fed. Cir. 1993)

"The prior art references in combination do not suggest the invention as a whole claimed in the ... patent. Absent such a suggestion to combine the references, respondents can do no more than piece the invention together using the patented invention as a template."

Moreover, where the art teaches away from what the applicant advocates, this is a strong indication of patentability as set forth in, for example,

Kloster Speedsteel AB v. Crucible, Inc., 793 F.2d 1565, 230 USPQ 81 (Fed. Cir. 1986), *on rehearing*, 231 USPQ 160 (Fed. Cir. 1986)

"That the inventor achieved the claimed invention by doing what those skilled in the art suggested should not be done is a fact strongly probative of nonobviousness."

Gillette Co. v. S.C. Johnson & Son, Inc., 919 F.2d 720, 16 USPQ2d 1923 (Fed. Cir. 1990)

"The closest prior art reference would likely *discourage* the art worker from attempting the substitution suggested by [the inventor/patentee]."

The withdrawal of the '103 rejections of all claims based on the combination of Slotwinski, et al. and Reeder is respectfully requested because the Slotwinski, et al. is a flawed primary reference as discussed above. Slotwinski, et al. does not have a "polarization preserving optical system resident in one of its interferometer legs" so fails in support of a prima facie case for obviousness and should be withdrawn on this basis alone. As such, the substitution of the "polarization preserving retroreflector" of Reeder for the polarization preserving fiber of Slotwinski, et al. would not produce the claimed invention because the fiber is not resident in one of the legs of the interferometer in the first instance. Moreover, the "retroreflector" of Reeder does not possess the reflecting properties of the claimed invention as defined in the specification under the discussion relating to "transformation properties" and as set forth hereinabove. The elements 13 and 21 of Reeder while polarization preserving, do not possess the transformation properties of those of the present invention. They do not satisfy the transformation properties for the two different orthogonal planes of rotation of an input beam since they do not invert the image in both orthogonal planes. This is obvious from Slotwinski, et al.'s Figs. 2 where y is not inverted but x is

inverted. This says that Slotwinski, et al's elements are not polarization preserving optical system as defined by the invention because to qualify as an inventive polarization preserving optical system it has to invert both. Reeder preserves motion in one plane while in motions in an orthogonal plane rotates them in opposite directions. That is, the input beam and the output beam of Reeder diverge. The same thing applies to the Fig. 3 sequence of Reeder. Consequently, Reeder fails to show what was alleged by the Office Action and should be withdrawn as a reference particularly in combination with Slotwinski, et al for reasons of record.

The rejection of claims 9-19 and 50-52 over Reeder is respectfully requested to be withdrawn for the reasons set forth in connection with the discussion of Reeder in combination with Slotwinski, et al. Reeder does not possess the transformation properties of the present invention. Moreover, Reeder is utilized in a completely different context than that of the present invention. The relevant components of Reeder are reflectors used in a Q-switched laser, which is clearly not an interferometer. Nor is there any suggestion in Reeder that its components be used for interferometric purposes. Consequently, this rejection should be withdrawn.

The rejections based on the combination of Slotwinski, et al. and Reeder in further view of Lehmann, et al. should be withdrawn since the basic combination of Slotwinski, et al. with Reeder is fundamentally flawed. Adding Lehmann, et al. cannot cure this defect. Consequently, this rejection is respectfully requested to be withdrawn.

The rejections based on the observation that polarization interferometers are well-known along with Reeder and in further view of Rando is respectfully requested to be withdrawn in view of the inappropriateness of Reeder as set forth above. Rando adds nothing of significance to this combination. Indeed, it does not even disclose "... the differently tilted retardation elements" of the rewritten claims so it is difficult to see how it could be used to render any of the claims obvious, particularly as now amended.

In view of the foregoing response, reconsideration and allowance of all claims remaining in this application is respectfully requested. If there are any questions regarding any aspect of this response, the Examiner should feel free to contact Applicants' attorney at the telephone number listed below.

No fee, other than that for the extension of time, is necessary in connection with this Amendment since the application as now amended contains the same number of total claims and independent claims as were originally filed.

Respectfully submitted,

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